eight of the olive-green water form and seven of the vermillion land form were examined. Every one of the former was abundantly supplied with the parasites, but only two of the land forms were infected.

All that is necessary to obtain living specimens of the trypanosomes for study is to snip off a little piece from the end of the tail, and then squeeze out several drops of blood on each slide. A cover glass can be added directly or a ring of vaseline may first be spread around the blood so that the preparation will be sealed when the cover glass is put in place. In such a preparation the spiral movement of the organism is evident, and the flagellum and undulating membrane are easily observed in action. The nucleus and other structures are clearly revealed in dried films stained with Wright's or Leishman's stains. Obtain a drop of blood near one end of a clean slide. Place the end of another slide near the drop of blood at an angle of about 30 degrees with the shorter end of the slide. Draw this slide along until it touches the drop. When the blood has spread along the edge, push the slide fairly rapidly toward the other end. A thin even film will result covering about one half of the slide. Allow this to dry. Then place a few drops of the stain on the film and allow to remain one minute. Add double the volume of distilled water and after five minutes wash the film with distilled water, and dry in the air. Balsam and a cover glass may then be added but the stain will fade. If oil immersion objectives are available no cover glass should be used but the oil placed directly on the film, and after the examination is completed this oil may be wiped off with lens paper or washed off with xylol. The stain may be obtained in small 0.1 gram tubes. This amount is dissolved in 10 c.c. of pure methyl alcohol and is then ready for use.

R. W. Hegner
School of Hygiene and Public Health,
The Johns Hopkins University

HORIZONTAL RAINBOWS

To the Editor of Science: With respect to Reese's account of an "unusual form of rainbow" in Science for December 12, 1919 (Vol. L., p. 542), it may be said that, in Europe, rainbows on the surfaces of ponds and lakes have been reported from time to time during the past fifty years. They have been observed, also, on several bodies of water in Japan during the past few years and the investigators of that country have given some attention to the mathematical explanation of these phenomena.

In the United States these spectral displays have been seen frequently on the surface of Lake Mendota at Madison, Wisconsin, during the past ten or twelve years. Some of these displays have been unusually brilliant and varied; double and triple primary bows together with a secondary bow have been noted at times. These phenomena have been described in the *Monthly Weather Review* for February, 1916 (Vol. 44, p. 65).

The complete bows that have appeared on the surface of Lake Mendota possessed a very different outline from the diagram shown by Reese. They were parabolic in shape instead of circular; neither did they possess an inverted segment connecting the outer extremities as in his figure.

As far as the present writer is aware, these horizontal rainbows have been reported for only two lakes in this country, namely, Lake Mendota and the lake referred to by Reese. This seems to indicate that it is not a widespread phenomenon, or else other observers have not taken the trouble to publish accounts of their observations. It would be interesting to know whether these spectral colors have been seen on any other bodies of water in this country.

Chancey Juday
Madison, Wisconsin

CHEMISTRY APPLIED TO COMMERCE

The divorce of science and industry, which has long been a noisesome skeleton in our economic household, is fast being annulled. "During the war, American industry acquired —or had thrust upon it—a wholesome respect for American science," *Drug and Chemical*

Markets said in a recent editorial, and this organ of commercial chemistry might well have added that at the same time American science learned the wholesome lesson that American industry has problems and aims not altogether ignoble. It is no longer the hallmark of the practical business man openly to hold in contempt all knowledge gained from books or laboratories. The man of science no longer believes that the application of his training and talents to practical problems is prostitution.

During the war period, the practical problems of the chemical industry were problems of production. American chemists helped solve these production problems, and, now that war conditions are passing, American chemical manufacturers naturally turn to them for help in solving the problems of distribution. This help must come finally from our colleges and universities.

It is not necessary for me to point out that chemical manufacture is a "key industry," nor to emphasize the fact that, if we are to keep the tremendous advantages we have won during the past five years in the development of the American chemical industry, a bitter trade war must be successfully waged. Soon our manufacturers will meet, both at home and abroad, the products of foreign competitors. Then the trade war will be declared in earnest, since our domestic consumption of chemicals is not sufficient to support a self-contained industry. Our Allies have all increased their chemical productivity greatly, and they appreciate, quite as well as we do, the vital importance of this industry. Germany has always had a nice comprehension of the place of chemicals in industry and in warfare, and her chemical equipment, both men and plants, is intact.

To make chemical products in competition with the world avails us nothing if we can not market them successfully in world-competition. Chemical manufacturing is the most diversified and technical of industries, and its basic conditions place a premium upon technical training; its productive branches are as complex, for the diversified products to be marketed are bought by many consumers and their uses are various and often highly technical. Men of technical, chemical training who can market our American-made chemicals are needed to-day.

Detailed, expert knowledge of the goods he handles is an important part of the salesman's equipment, for, since he can no longer sell his customers by means of cigars and jokes, he must render them a service. This service is often expert advice. Dyes must be properly applied; medicinals must be intelligently prescribed; aromatics must be skillfully combined. New markets must be developed for old chemicals and new products must be introduced. A smattering of chemical trade jargon is poor equipment for such work, and it is worth remembering that the German dye trusts took pains to send out salesmen trained in the chemistry of dyestuffs and speaking the language of the countries they visited. The haphazard supply of men who have taken more or less chemistry at college and who chance to become salesmen is in no way able to meet this kind of selling competition. Graduates in chemistry are seldom fitted by temperament or experience for this work: salesmen are not often equipped with technical training. Chemistry applied commercially to distribution is even further removed from the pure science than are industrial research and production work. The commercial instinct, however, is not to be condemned, and courses in commercial chemistry would attract undergraduates who, after a year's course, would normally drop out of the ken of the chemistry department. The training of so-called chemical engineers has brought to the study of chemistry many students anxious to become plant executives, but quite indifferent to analysis, research, or teaching. Courses in commercial chemistry would, in like manner, open up new opportunities.

The foundation of such courses would naturally be a broad one of chemistry upon which could be raised a working knowledge of analysis and of important industrial processes. The uses of chemical products in the industries—steel, textile, leather, rubber, paper,

glass, fertilizers, etc.—ought to be treated in such courses, and crude drugs, essential and fixed oils, and petroleum, are products closely allied commercially to chemicals about which the student should know something. A series of lectures on the chemical markets—how chemicals are sold, containers, insurance, fire risks, sales contracts, etc.—might well be delivered by some sales manager or broker familiar through daily, practical experience with this subject. Supplementary courses in applied economics, such as given in many of the larger universities on banking and finance, commercial law, traffic and transportation, business administration, advertising, and even actual salesmanship, might to advantage be offered to the students of commercial chemistry.

A definite and very real need for men with technical training in chemistry as applied to commerce exists and, as yet, there has been no systematic, serious effort on the part of our colleges and universities to supply this demand. Young men equipped with this training would find places in the most highly paid branch of industry open to them, and institutions giving this training would increase the scope of their chemistry departments. Moreover, to supply the American chemical industry with technically trained merchandizing experts will strengthen a "key industry," necessary to national prosperity and, in event of war, essential to national preservation.

WILLIAMS HAYNES

NEW YORK CITY

SCIENTIFIC BOOKS

The Physical Chemistry of the Metals. By RUDOLPH SCHENCK, Professor of Physical Chemistry in the Technischen Hochschule in Aachen. Translated by REGINALD SCOTT DEAN, Research Metallurgist, American Zinc, Lead and Smelting Company. New York. John Wiley and Sons, Inc. 1919. VIII + 239 pages.

It is surprising that this book published in Germany in 1908 should have escaped the eye of the translator until now. It is, however, most encouraging to the future of American industry to find the translator connected with one of the large metallurgical plants. Usually texts which deal largely with theoretical subjects are translated by college men for use in their classes and find their way into the practical field only indirectly. It is, therefore, doubly welcome to see a translation emanating from an industrial plant.

The book deals very largely with principles, but is eminently practical for the metallurgist. The chapter headings: I. Properties of Metals; II. Metallic Solutions and Alloys; III. Alloys of Metals with Carbides, Oxides and Sulphides, Iron and Steel, Mattes, Phase Rule; IV. Metallurgical Reactions, Oxidation and Reduction; V. Decomposition of Carbon Monoxide, Blast Furnace Process; VI. The Reactions of Sulphides give a good idea of the subject matter contained in the book. All of this material is essential to the well-trained metallurgist, but particularly that in the last four chapters. Each subject is treated briefly, but clearly and special emphasis is laid upon equilibrium phenomena and the factors which influence equilibrium. The reactions between carbon and oxygen and metallic oxides receive the full attention they deserve.

With the many merits which the book has it is surprising that it has some simple faults which might easily have been corrected. As examples might be mentioned the following: the omission of the eutectic lines in the diagram on page 51; the form of curves 1, 2, and 4 in diagram on p. 50; the inadequacy of the treatment of Crystal Growth on p. 20; the synonymous use of the terms martensite and austenite; the use of the term sorbitic as applied to chilled cast iron. These are, however, unimportant and it is hoped and believed that the book will be a distinct help to American metallurgists.

H. F.

SPECIAL ARTICLES

THE DEVELOPMENTAL ORIGIN OF THE NOTOCHORD

THE notochord is so constant, fundamental and distinctive a structure in the Chordate